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Editor: George Sell

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U.K. PETROLEUM TRADE IN 1952

By GEORGE SELL (Fellow)

With an increase of 38.6 per cent over the 1951 total, imports of crude petroleum into the U.K. during 1952 reached a figure of nearly 6000 million gallons and represented 78.6 per cent of the total import of crude plus refined oils. On the other hand the total import of refined products was lower by 39.3 per cent. Thus, the total import at 7,596,922,000 gallons was higher by 8.8 per cent than the 1951 figure of 6,981,385,000 gallons.

All imports of liquid refined products were considerably lower than in 1951, the highest reduction being 51 per cent for motor spirit. For the other oils the reductions were 46.5 per cent in the case of gas oil, 41.9 per cent for fuel and diesel oils, and 21.7 per cent for kerosine. Details extracted from the returns* are given in Table I.

There were also considerable reductions in the imports of solid and semi-solid products, details of which are given in Table I.

The increasing importance of crude petroleum for refining in the U.K. is shown by Table II, which indicates that in the four years from 1949 imports of crude have more than doubled in terms of percentage of total. The most striking decrease is for motor spirit—a reduction in the import proportion from 28.8 per cent in 1949 to 6.7 per cent in 1952.

C.I.F. Values

As noted in previous years the trend to higher costs of petroleum imports

*"Accounts relating to trade and navigation of the United Kingdom, December 1952". HMSO, London.

TABLE I

QUANTITY AND VALUE OF U.K. PETROLEUM IMPORTS

	1952		1951		1950	
	Quantity 1,000 *gal*	*Value* £	*Quantity* 1,000 *gal*	*Value* £	*Quantity* 1,000 *gal*	*Value* £
Crude petroleum	5,972,534	238,899,037	4,308,974	159,171,661	2,369,258	74,256,473
Motor spirit	509,049	32,319,448	1,039,852	59,164,971	1,217,003	59,310,668
Other spirit	50,482	3,185,248	51,187	3,121,527	30,255	1,686,440
Kerosine	406,585	22,083,658	503,008	25,133,076	389,830	17,360,195
Lubricating oil	109,180	13,335,143	111,488	14,257,099	119,173	10,131,667
Gas oil	211,337	11,641,971	395,341	19,024,522	369,165	15,201,956
Fuel and diesel oils	337,508	13,107,487	570,994	20,025,958	572,965	15,112,813
Other sorts	247	39,924	541	124,862	954	436,579
Total refined products	1,624,388	95,712,879	2,672,411	140,852,015	2,699,356	119,240,318
GRAND TOTAL	7,596,922	334,611,916	6,981,385	300,023,676	5,068,614	193,496,791
	CWT.		CWT.		CWT.	
Paraffin wax	456,766	1,551,399	1,170,831	4,463,596	596,984	1,860,268
Mineral jelly	124,961	384,121	212,581	684,616	179,759	436,536
Carbon black from natural gas	129,137	699,930	886,479	4,063,535	867,110	3,596,426
Natural asphalt and bitumen	56,889	721,111	57,537	692,381	54,653	552,611

continued in 1952, with crude petroleum up by 8.3 per cent and refined products 11.8 per cent higher in the aggregate. All the principal products rose in value, with the exception of lubricating oils which were slightly lower. As regards individual products, gas oil was up by 14.5 per cent, motor spirit by 11.6 per cent, and fuel and diesel oils by 10.8 per cent. Details are given in Table III.

Consigning Countries

In Table IV are given details as to the countries from which oils were consigned to the U.K., these countries not necessarily being the country of origin of the import. For the first time the amounts of crude petroleum imported from Kuwait have been separated from the group total of that and neighbouring states, and this discloses that in 1952 and probably also in 1951 Kuwait was the largest supplier of petroleum to the U.K.

Comparing 1952 with 1951, it is noteworthy that for 1952 the three leading suppliers were concerned with crude petroleum only and were all in the Middle East area. In the cases of most other countries there were decreases in all totals except for the British West Indies and France.

TABLE II

PERCENTAGE IMPORTS OF PETROLEUM INTO THE U.K.

	1952	1951	1950	1949
	Per cent			
Crude petroleum	78.6	61.7	46.8	33.2
Motor spirit	6.7	14.9	24.0	28.8
Other spirit	0.7	0.8	0.6	0.7
Kerosine	5.4	7.2	7.6	9.3
Lubricating oil	1.4	1.6	2.4	1.5
Gas oil	2.8	5.6	7.3	9.8
Fuel and diesel oils	4.4	8.2	11.3	16.7
	100.0	100.0	100.0	100.0

TABLE III

AVERAGE C.I.F. UNIT VALUES OF U.K. PETROLEUM IMPORTS

	1952	1951	1950
	£ *per* 1,000 *gal*		
Crude petroleum	40.00	36.94	31.35
Motor spirit	63.49	56.89	44.62
Other spirit	63.10	60.98	55.65
Kerosine	54.31	49.97	44.46
Lubricating oil	122.14	127.88	84.94
Gas oil	55.09	48.12	41.09
Fuel and diesel oils	38.84	35.07	25.89
Other sorts	161.63	230.80	456.80
Total refined products	58.92	52.71	44.04
	£ *per cwt*		
Paraffin wax	3.40	3.81	3.29
Mineral jelly	3.07	3.22	2.43
Carbon black	5.42	4.36	4.15
	£ *per ton*		
Natural asphalt and bitumen	12.68	12.03	10.11

Table IV

Countries Consigning Petroleum to the U.K.

Country and Product	1952	1951	1950
	Thousand gallons		
Kuwait:			
Crude petroleum	3,399,842	*	*
*Included with Bahrein, Qatar, and Trucial Oman.			
Iraq:			
Crude petroleum	1,053,031	144,566	126,872
Saudi Arabia:			
Crude petroleum	880,954	1,005,867	278,508
Netherlands Antilles:			
Crude petroleum	197,771	284,463	278,916
Motor spirit	148,760	407,895	390,106
Kerosine	212,509	261,614	194,956
Lubricating oil	14,128	16,994	20,623
Gas oil	12,859	42,702	49,173
Fuel and diesel oils	91,401	226,733	76,413
	677,428	1,240,401	1,010,187
United States of America:			
Crude petroleum	22,015	25,581	19,827
Motor spirit	121,649	236,978	77,377
Kerosine	44,496	66,044	7,299
Lubricating oil	89,305	88,563	94,527
Gas oil	107,751	105,314	39,454
	385,216	522,480	238,484
Bahrein, Qatar, and Trucial Oman:			
Crude petroleum	211,349	2,229,632†	931,252†
Motor spirit	28,342	59,725	91,595
Kerosine	5,707	11,573	14,823
Gas oil	10,429	29,205	33,820
	255,827	2,330,135	1,071,490
†Including Kuwait.			
British West Indies:			
Motor spirit	51,079	54,331	66,508
Kerosine	115,665	52,035	40,255
Gas oil	16,894	26,122	16,567
Fuel and diesel oils	28,041	46,976	52,899
	211,679	179,464	176,229
Venezuela:			
Crude petroleum	149,348	104,585	74,524
Motor spirit	16,075	137,235	205,154
Kerosine	18,171	28,995	1,363
Gas oil	15,490	116,053	102,311
	199,084	386,868	383,358

Country and Product	1952	1951	1950
	Thousand gallons		
Netherlands:			
Motor spirit	64,531	71,718	95,297
Gas oil	720	14,713	40,491
Fuel and diesel oils	63,476	47,871	146,314
	128,727	134,302	282,102
France:			
Motor spirit	35,853	24,077	39,978
Gas oil	45,494	43,856	54,657
	81,347	67,933	94,635
Peru:			
Crude petroleum	35,308	36,010	37,858
Persia:			
Crude petroleum	—	436,425	606,742
Motor spirit	—	35,867	242,416
Kerosine	—	80,753	129,266
Gas oil	—	—	6,106
Fuel and diesel oils	—	138,720	273,043
		691,765	1,257,573
Sarawak:			
Crude petroleum	—	29,777	9,065
Mexico:			
Gas oil	—	17,324	26,354
Other British:			
Motor spirit	20	33	—
Kerosine	223	—	—
Lubricating oil	173	28	19
Gas oil	386	11	201
Fuel and diesel oils	2,689	25,903	5,874
	3,491	25,975	6,094
Other Foreign:			
Crude petroleum	22,916	12,068	5,694
Motor spirit	42,740	11,993	8,577
Other spirit‡	50,482	51,187	30,255
Kerosine	9,814	1,994	1,868
Lubricating oil	5,574	5,903	4,004
Gas oil	1,314	41	31
Fuel and diesel oils	151,901	84,791	18,422
Other sorts‡	247	541	954
	284,988	168,518	69,805

‡Includes also imports from "Other British" sources.

Table V

U.K. Petroleum Imports by Zones of Consignment

	1952		1951		1950	
	1,000 *gal*	*% of total*	1,000 *gal*	*% of total*	1,000 *gal*	*% of total*
Middle East	5,589,654	73.6	4,172,333	59.8	2,734,443	53.9
Caribbean and Peru	1,123,499	14.8	1,842,743	26.4	1,607,632	31.7
U.S.A. and Mexico	385,216	5.1	539,804	7.7	264,838	5.2
Europe	210,074	2.7	202,235	2.9	376,737	7.5
Other and undisclosed areas	288,479	3.8	224,270	3.2	84,964	1.7

On a zonal basis, as recorded in Table V, the main point to be noted is continued rise in percentages from the Middle East zone, while the Caribbean area and Peru has declined still further.

Re-Exports

In 1952 re-exports of imported petroleum products were comparatively small in relation to previous years and details are given in Table VI. In the case of oil fuel shipped for bunkers in steamers (including fishing vessels) a new record was established with an increase of 16.4 per cent over 1951. Strictly, this is not an export and no details as to value are given.

TABLE VI

U.K. RE-EXPORTS OF IMPORTED PETROLEUM

	1952	1951	1950
	Thousand gallons		
Motor spirit	3,160	20,107	12,087
Kerosine	1,406	4,201	3,417
Lubricating oil	1,237	2,284	2,087
Gas oil	549	3,754	3,286
Fuel and diesel oils	10	1,530	4,784
All other sorts	184	293	871
TOTAL	6,546	32,169	26,512
Value	£578,972	£2,233,634	£1,352,638
Oil fuel shipped for use in steamers	814,566	699,579	525,895

Exports

Exports from the U.K. of oils produced or manufactured in the country were 81.3 per cent higher than 1951, thus continuing the increase which has now been noted for several years. The corresponding value was 73.7 per cent higher in the aggregate, individual values in £ per 1,000 gallons being: motor spirit, £55.8 (£53 in 1951); kerosine, £54.7 (£49.5); lubricating oil, £178.7 (£175.9); gas oil, £46.7 (£43.2); diesel oil, £40.4 (£36.8); fuel oil, £29 (£26.3); all other sorts, £92.3 (£76.1).

TABLE VII

U.K. EXPORTS OF HOME-PRODUCED AND HOME-MANUFACTURED PETROLEUM

	1952		1951		1950	
	Quantity 1,000 *gal*	*Value* £	*Quantity* 1,000 *gal.*	*Value* £	*Quantity* 1,000 *gal*	*Value* £
Motor spirit	109,833	6,131,503	35,582	1,884,625	29,368	1,394,049
Kerosine	29,914	1,635,671	10,468	518,245	7,808	357,979
Lubricating oil	47,065	8,410,738	42,822	7,520,101	30,925	5,105,119
Gas oil	94,842	4,432,909	39,288	1,697,671	19,390	743,473
Diesel oil	139,738	5,647,086	76,943	2,832,327	35,989	1,155,738
Fuel oil	875,448	25,361,995	555,775	14,612,487	143,763	3,487,811
All other sorts	7,916	730,887	14,018	1,067,084	4,715	564,078
TOTAL	1,304,756	52,350,789	774,896	30,132,540	271,958	12,808,247
	Cwt		*Cwt*		*Cwt*	
Lubricating compounds	308,100	1,270,454	341,414	1,251,228	233,306	742,510
	Tons		*Tons*		*Tons*	
Manufactured bituminous asphalt and emulsions	77,597	1,882,185	84,503	1,500,472	66,650	1,064,717

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Electrical Engineers Exhibition—The Association of Supervising Electrical Engineers is holding its second exhibition at Earls Court during 25-28 May from 10 a.m. to 6 p.m. Admission is by ticket obtainable from the Association, 35 Gibbs Green, Edgware, Middlesex.

Centrifuges. A new booklet "Bowl functioning principles of the Sharples Super-Centrifuge" (Bulletin No. 452) is illustrated by twelve excellently clear diagrams. Copies from Sharples Centrifuges Ltd., "Tower House," Woodchester, Stroud, Glos.

An artist's impression of the new £40 million oil refinery now under construction at Aden

AIOC'S ADEN REFINERY

By the end of 1954, the new 5-million tons refinery which Anglo-Iranian is erecting on Little Aden, ten miles west of Aden town, is due to begin working. Already men and materials are reaching the site and construction work on the two camps which will house about 10,000 workers has started. Of this number, approximately 2000 will be Europeans and eventually a township including staff quarters and modern amenities will be built close to the refinery. Pending completion of quarters on shore, many of the 300 British and 50 American technicians are living on the liner *Dorsetshire* which is anchored off the site. Local labour is being recruited for the extensive construction programme and contracts have been signed with Middle East Bechtel Corporation and George Wimpey & Co. Ltd. for the construction of the refinery. The latter company are also under contract to build the oil port.

When completed the refinery and tank farms will cover an area of approximately 270 acres, and the plant will include two atmospheric distillation units complete with stabilizers and caustic treaters, one platforming unit,

S. W. Adey

H. L. Ray

R. H. Sheldrake

and a sulphur-dioxide extraction unit for improving the quality of kerosine. The power station will generate 30,000 kW and the installed capacity of the boiler battery will be 600,000 lb/hr.

Responsibility for overall planning and commissioning of the refinery is in the hands of S. W. Adey, B.Sc., A.R.C.S., F.R.I.C., A.M.Inst.Pet., who is the manager of Anglo-Iranian's Middle East Division, Refineries Department. Associated with Mr Adey with the task of co-ordinating all phases of the work is Mr H. L. Ray, while R. Hedley Sheldrake is resident manager for the project.

* * *

"THE LUBRICATION OF OIL ENGINES"

Recently issued by Shell-Mex and B.P. Ltd., this book of 147 pages is a comprehensive survey of modern practice in the operation and lubrication of industrial oil engines. After discussing the engine types and operation cycles, the various methods of fuel injection and combustion are considered, and then a chapter is devoted to scavenging and pressure charging. Bearing lubrication and lubricants are dealt with in two chapters, followed by a chapter on oil purification. Troubles encountered in operation are then covered, and the methods of power transmission are outlined. Copies are obtainable from divisional offices of the Company.

* * *

PLANT MAINTENANCE

Early in 1952 a British Productivity Team of ten members visited the United States to investigate the subject of plant maintenance. They made a tour covering some 4,000 miles in the Eastern States and among the 16 plants visited was the Baytown, Houston, Texas, refinery of the Humble Oil & Refining Co.

The 66-page report of the team, which included among its members D. G. Hitt, M.B.E., M.Inst.Pet., chief mechanical engineer, Refineries Department, Anglo-Iranian Oil Co. Ltd., covers all aspects of plant maintenance and draws conclusions and makes recommendations on specific matters. Copies, price 2s. 6d. post free, are obtainable from the British Productivity Council, 21 Tothill Street, London, S.W.1.

* * *

OIL FUEL BURNER EXPORTS

During 1952 the U.K. exported 25,960 cwt of oil fuel burning equipment, valued at £630,125, compared with 25,684 cwt in 1951 valued at £599,870.

* * *

I.C. ENGINE EXPORTS

U.K. exports of internal combustion engines during 1952 totalled 1,958,212 b.h.p., valued at £25,345,783. Details as to b.h.p. for previous years are not available, but total value in 1951 was £25,089,061. The 1952 exports were made up as follows:

	B.h.p.	£
Marine engines:		
C.I. (diesel):		
Not over 50 b.h.p.	49,969	908,905
Over 50 to 300 b.h.p.	88,494	1,201,621
Over 300 b.h.p.	54,222	913,048
Other (incl. kerosine, gasoline, and semi-diesel)	86,194	489,466
	278,879	3,513,040
Other types:		
C.I. (diesel and dual fuel):		
Not over 50 b.h.p.	780,014	11,838,107
Over 50 to 300 b.h.p.	333,965	4,428,936
Over 300 b.h.p.	251,548	3,330,371
Kerosine, gasoline, and other spirit:		
Not over 10 b.h.p.	174,691	1,934,550
Over 10 b.h.p.	137,976	289,601
Other (incl. gas and semi-diesel)	1,139	11,178
	1,679,333	21,832,743
Grand total	1,958,212	25,345,783

In addition, parts to the value of £10,026,774 were exported in 1952, compared with £7,872,442 in the previous year.

AROUND THE BRANCHES

FAWLEY, LONDON, NORTHERN, PERSIAN GULF, SCOTTISH, SOUTH EASTERN, SOUTH WALES, STANLOW, TRINIDAD

Fawley Branch

A meeting of the Branch at the Esso Recreation Club, Holbury, on 19 December 1952 was attended by nearly 50 members and E. A. Evans delivered his address on "Lubrication—engineer or chemist?"

London Branch

Members of the London Branch and visitors heard an interesting, amusing, and informative talk on Petroleum Waxes given by S. T. Minchin on 21 January.

The speaker, who is a well-known authority on waxes, described the difference between paraffin and microcrystalline waxes, methods of extraction by pressing and sweating and by solvent extraction, the structure of waxes, and their various properties. Mr Minchin's verbal descriptions of the effect of temperature on wax structure were both novel and colourful and clearly portrayed the molecular movements involved to his predominantly lay audience. The list of uses for which waxes are employed today was a surprise to many of those present. Mentioned were the use of waxes in food packaging and in preserving cheeses and fruit, the manufacture of candles, matches, and gramophone records, and applications in the leather, cosmetics, and rubber industries, and for the plucking of poultry. Another point of interest is that wax is by far the most expensive of all petroleum products, the value of microcrystalline wax exceeding that of paraffin wax.

After the meeting the speaker was entertained to dinner by the Branch at a neighbouring hostelry and thus concluded a very enjoyable evening.

Northern Branch

At the meeting on 20 January, when the chair was taken by T. W. Ranson, 30 members and guests were present and Dr E. S. Paice delivered an address

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THE FLOODS

Anglo - Iranian's Kent oil refinery, at the junction of the Thames and the Medway, was a victim of the recent disastrous floods. This picture shows the extent of the flooding around the site of the cat cracker. Despite the flooding the distillation unit was commissioned on 20 February. (an AIOC photo)

on the use and character of new chemicals from petroleum. This was a most interesting and instructive paper and it gave rise to many questions. A vote of thanks was carried on the proposition of Mr O'Brien.

A meeting of the Branch Committee was held prior to the general meeting and at this J. E. Haslam and E. J. Dunstan intimated their desire to retire from the Committee. Mr Haslam said that he found it necessary to shed some of his commitments and, as he had been on the Committee almost from the foundation of the Branch, felt it was time he made way for a new member. Mr Dunstan, regretting that his frequent absences from Manchester necessitated his resignation from the Committee, supported Mr Haslam's contention that new members on the Committee would be valuable. On behalf of the Committee, the chairman thanked both gentlemen for the work they had done in the past.

Persian Gulf Branch, Bahrein Sub-Area

On 14 December 1952, the Bahrein Sub-Area of the Persian Gulf Branch met at Awali, Bahrein. The guest speaker was Dr A. J. S. Perfect, a member of the medical staff in Awali, and his subject was "Oil, medicine, and the Middle East". The guests included several people from Qatar and Arabia.

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Blasting at Coryton. Preparing a channel for the return of clarified cooling water to the Thames from Vacuum Oil Co's new refinery.

Dr Perfect in a very interesting and sometimes amusing talk emphasized some of the influences for good of the petroleum industry which are often overlooked. "It is my impression," he said, "that the oil industry ranks only second to the armed services in sending personnel to remote parts of the world." Because oil seems to occur in arid deserts, jungles, or swampy areas, adequate "preventive", or, as he preferred to call it, "constructive" medicine is necessary to make life free from the diseases which are associated with such places. The oil industry has brought health to the people living in those areas directly (by improved sanitation, education, and pest control) and indirectly by increasing the local standard of living.

The advantages achieved by direct methods of "constructive" medicine are:

1. The ultimate reduction in cost of medical programme;
2. Greater efficiency of the employee and reduced absenteeism;
3. Better general health of the community as a whole;
4. Greater life expectancy and working age.

Dr Perfect then described some of the diseases prevalent in the local areas together with methods of diagnosis and cure. He concluded that medical progress had been speeded up by the coming of the oil industry to the Middle East.

Those taking part in the discussion which followed the talk included the chairman, R. Godfrey, Dr L. J. Moody (Bahrein) and Dr G. V. Young (Arabia), H. G. Russel, R. E. de Mestre, K. Grisewood, N. E. Watson, W. T. Barrett, H. G. Spence, J. D. Clark, W. H. Cotter, and K. S. Lennie (members) and K. D. Romine, F. W. B. Harris, R. H. Meeker, and W. J. Kibble (guests).

Scottish Branch

The Annual General Meeting of the Scottish Branch was held in Edinburgh on 8 January. Robert Crichton, J.P., F.H-W.C., presided.

The Chairman reported on the previous session's work and stated that the Membership now included 72 Corporate and 83 Non-Corporate Members. He indicated that, by the death of the Vice-Chairman, J. T. Guthrie, and the retiral from the Committee of Dr W. M. Cumming, to both of whom Mr Crichton paid tribute for their services to the Branch since its inception in 1938, two vacancies on the Committee require to be filled. A third vacancy was occasioned by the retiral under Rule 4(c) of J. M. Caldwell. On the motion of J. A. Brown, seconded by J. MacWilliam, it was unanimously agreed to appoint J. M. Caldwell, F.H-W.C., George Grant, F.R.I.C., and Dr W. B. Peutherer, F.R.I.C., F.H-W.C., to the Committee. George Fleming and George Dewar were appointed auditors.

Following the A.G.M., Dr W. L. Wood, M.Sc., M.I.Chem.E., A.R.I.C., of British Petroleum Chemicals Ltd., gave a lecture on "The conversion of petroleum into alcohols", which is summarized as follows:

The geographical accident of the immense reserves of petroleum in the U.S.A. gave that country the opportunity over 30 years ago of utilizing olefinic hydrocarbons as a source of organic chemicals. The olefins were first used in the debutanized tail gas streams using preferential acid absorbents, but later the propylene cut was isolated and sulphated, the depropanized residue gas being then used for ethanol, and finally the residue gas was fractionated to give practically pure ethylene for modern processes. Whilst olefin-using industries were growing, changes in cracking technique were reducing gas formation per barrel of charge and the gas was becoming more paraffinic, so that it became necessary to develop gas cracking and in some cases to deep crack petroleum fractions to get gas as a major product. As there is no natural gas in the U.K. and no large refineries in existence before this decade, attention has been directed to the special high temperature crackers of petroleum fractions. This has been commercialized in recent years by five companies, all of which produce one

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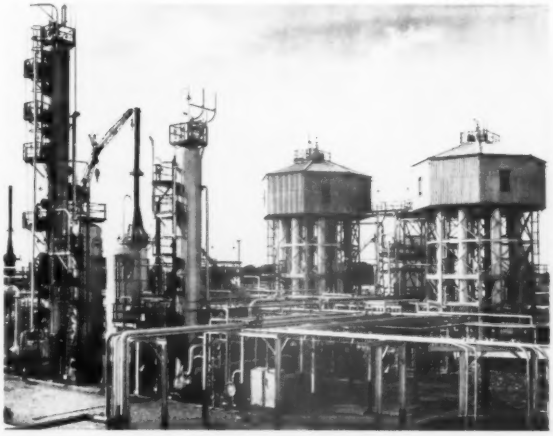

FAWLEY POLY PLANT
Recently completed at the new Fawley refinery of Esso Petroleum Co. Ltd., is this polymerization plant

or both of the two alcohols, ethanol or isopropanol. The range of final temperature used in these crackers is 1250° to 1500°F, the higher temperatures being attained by adiabatic reaction of partially cracked vapours by mixing with highly superheated steam. Steam is normally used in the cracking coils of this type of cracker for a fourfold purpose: to facilitate vaporization, to increase turbulence and allow of higher heat input rates, to favour the ethylene side of the ethylene/ethane equilibrium, and perhaps most important, to effect continuous carbon removal from the tube walls by the water-gas reaction which at these temperatures proceeds faster than coke lay-down. Under commercial cracking conditions the yield of ethylene, propylene, and butylenes are directly proportional to the paraffin content of the feed stock over a range of 50–100 per cent paraffinicity. The period of subjection of the oil vapours to gas-forming conditions is about one second and curves have been developed to predict alterations in yields due to alterations in time and temperature.

The two methods of complete gas separation are straight fractionation and absorption with reboil heat. The relative effects of high- and low-pressure operation with respect to relative volatility, power requirements, and number of cascade cycles were described and it was shown how the pressure conditions of the fractionating columns are fixed within limits by availability of the refrigerants.

Ethanol and isopropanol are both produced by sulphation or direct hydration. The general conditions of direct hydration are set by thermodynamic limitations of the system within a relatively close range of temperature and pressure which can be forecast from basic equilibrium equations. There is a long history of catalyst development, the difficulties encountered being high corrosion rates with liquid acid baths, low reaction rates with non-acidic solid catalysts, and poor mechanical strength with acidic solid catalysts. Although direct hydration avoids the use of heat to concentrate sulphuric acid the thermodynamics of the reaction show that a large amount of steam must be used in the reaction per ton of alcohol produced and a comparable amount of heat must be used to raise this steam.

Alcohol production by sulphation is basically simple, the predominating economic factor being the concentration spread between hydrolysing and sulphating conditions. Low concentrations during hydrolysis are necessary to obtain complete hydrolysis and to avoid reversion to propylene by dehydration, whilst high concentrations during sulphation enable the equipment to be kept within reasonable limits. The major difficulty is the contamination of the acid operating in a closed cycle.

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When the 4300-ft. sea loading line of 16-inch dia was completed and under test, the flexible hose connexions were examined by a diver. (a Shell photo)

South-Eastern Branch

The second Annual General Meeting of the Branch was held on 6 January.

N. W. Grey, the Chairman, gave a brief account of the activities of the Branch since its formation in February 1952, and considered that the year had been very successful.

A new Committee was elected as follows: N. W. Grey, Chairman (*Anglo-Iranian*); R. Chappells (*Kent Oil Refinery*); A. Hamilton-Smith (*Kent Oil Refinery*); R. D. Hayward (*Berry Wiggins*); F. W. Martin (*Berry Wiggins*); W. H. Lilly (*Woodfield Hoist*); F. H. Sanderson (*Samuel Williams & Sons*); F. A. Maliphant, Secretary (*Anglo-Iranian*); A. Chatting, Treasurer (*E. B. Badger*).

J. K. Anthony and E. A. Massey (Kent Oil Refinery) were elected Honorary Auditors.

At the Ordinary General Meeting following the A.G.M. an interesting paper was presented by L. C. J. Bailey, Shell-Mex and B.P. Lubricants Division, on "The trend in lubrication".

In a short space of time Mr Bailey covered the development of lubrication in many of its phases, especially those dealing with detergent oils for motor car engine lubrication.

A lively discussion followed and the questions answered dealt with both the technical and economic aspects of lubrication.

The vote of thanks was proposed by F. A. Maliphant.

South Wales Branch

On 4 December 1952, under the chairmanship of T. F. Perry, Branch Vice-Chairman, the South Wales Branch met to hear a talk by G. Halter, plant engineer at the National Oil Refineries Ltd. on "Focus on maintenance".

Mr Halter's talk was based on his experience as a member of a Productivity Team which went to the U.S.A. to study plant maintenance, covering there some 4000 miles and visiting 17 plants of varied types.

Prefacing his lecture with the statement that maintenance is a service to production, Mr Halter said that too frequently effort was concentrated to effect repair with emphasis on speed rather than permanency. The purposes of maintenance were:—

(*a*) To keep plant and equipment—production and service—in a condition to perform continuously the function for which it was designed;
(*b*) To assist keep total production costs at a minimum;
(*c*) To increase the efficiency of the actual maintenance work while

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FLOODS AT SHELL HAVEN
A flooded area in Shell's refinery at Shell Haven, Essex. The water has since drained away and it is understood that the sea wall was not damaged, the water flowing in from breaches down the river. (a Shell photo)

it is being performed and in that way increase the availability of plant for production;
This means not only the reduction of time taken to do individual items of maintenance, but the use of improved methods, so that the necessity for that item will recur less frequently;

(*d*) To improve the operation of plant while in production;

(*e*) To improve working conditions in the plant and its vicinity for the benefit of all employees.

If these aims were accepted it followed that the purpose of maintenance must be a continuous and not an intermittent function.

Maintenance could be classified under five headings:—

1. Controlled by production supervision;
2. Breakdown maintenance;
3. Scheduled maintenance;
4. Planned maintenance;
5. Preventive maintenance.

Discussing wear rates, the lecturer advocated the use of scientific lubrication and the issue of lubrication instruction manuals.

Much attention was given to method, study, and work measurement which has enormous scope in increasing the efficiency of a maintenance organization.

Among a great variety of improved methods a few were listed: Using the correct material for the work or conditions; using modern tools and mechanical aids; plant protection.

It was stated that where work measurement had been applied to maintenance in varying industrial plant, the utilization of labour force ranged between 40 and 75 per cent of the possible.

With improved methods and the introduction of preventive maintenance technique these figures can be increased to 80 to 85 per cent.

The lecturer went on to discuss the financial control of maintenance recommending the graphical rendering of statistics making for greater use of and interest in the information.

This was followed by maintenance technique, emphasizing the proper preparation of the job before the craft labour was brought to the site.

Concluding, the lecturer touched on design for ease of maintenance and what this factor could do in increasing the time efficiency of a running plant.

A most interesting discussion was followed by a vote of thanks, proposed by C. M. Dalley and seconded by D. W. Thomas.

Mr Halter then showed a varied and large number of photographs taken during the visit to the U.S.A.

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"TEACH YOURSELF MECHANICAL ENGINEERING"

Recent additions to the "Teach Yourself" series published by English Universities Press are three volumes on mechanical engineering—Vol. 1, Hand tools: descriptions and uses; Vol. 2, Engineering Components and Materials; Vol. 3, Workshop practice. They are written and illustrated by A. E. Peatfield (Anglo-Iranian Oil Co.), who is a member of the IP London Branch and an evening lecturer in mechanics at the LCC Schools of Building.

Each volume contains about 200 pages and is complete in itself. All are excellently illustrated with numerous diagrams and are written in language as easily understandable by the novice as by the qualified engineer. The price of each volume is 6s. net.

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FIRE PROTECTION

As vaporizing liquids, such as carbon tetrachloride, used for extinguishing oil fires are toxic or give toxic decomposition products, alternative extinguishers have been investigated. Two suggestions were methyl iodide and chlorobromomethane, and tests made at the Fire Research Station are reported in FPA Technical Bulletin No. 11, "A comparison of the extinguishing effect of chlorobromomethane, methyl iodide, and carbon tetrachloride," by E. H. Coleman. Copies are available on application to the Fire Protection Association, 84 Queen Street, London, E.C.4.

PERSONAL NOTES

J. R. Bradford, O.B.E., M.Inst.Pet., has taken up an executive position on the technical side of the Bristol Aeroplane Co. Ltd., Engine Division. He had previously been with the Shell Group for 16 years and for the last three years has been aviation advisor in the Technical Department of Shell-Mex and B.P. Ltd.

L. Soulal, M.Inst.Pet., who has been appointed manager of Vacuum Oil Co's Birkenhead works, joined the company in 1943 after having been with London and Thames Haven Oil Wharves Ltd. for some years. He succeeds the late E. R. Slater.

J. S. Trendell became assistant manager, Head Office Distribution Department of Shell-Mex and B.P. Ltd., on 1 February, and was succeeded as operations manager, North-Eastern Division, by **J. F. Brodie,** manager of Salt End Installation.

A. J. Good, Ph.D., has been appointed managing director of E. B. Badger & Sons Ltd. in succession to **R. E. McCurdy,** who is returning to the U.S.A. **J. H. Rehm** has been appointed resident operations manager in Australia and **E. F. Jaquith** engineering manager at Battersea.

Recent retirements from Vacuum Oil Company are by **George Hiley,** after 46 years on the marketing staff of which 33 years were in the South Lincolnshire area, and by **R. J. McMillan,** for 37 years an industrial salesman mostly in the London area.

Joseph W. Smith, B.S. (*left*), recently appointed general manager of construction of The M. W. Kellogg Co., joined the firm in 1936 in its construction department. **Henry P. Wickham** (*right*), who has been selected to manage the Operating Division, has a long association with the Company's catalytic process developments.

H. A. Wilson, who recently retired from his directorship of Esso Transportation Co., has had 30 years service with the Esso Group. Among his contributions in the field of tanker design and equipment are the use of compressed air in salvage, the use of a fire pump for lifeboats, fuelling at sea, and work on the fireproof lifeboat devised by the Petroleum Board.

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PRESIDENTIAL ADDRESS

Following the Annual General Meeting of the Institute held at 26 Portland Place on 21 April, the President, H. S. Gibson, C.B.E., will deliver a presidential address.

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Radio-Isotope Instruments. A second edition has been published of the brochure on instruments and accessories for radio-isotope applications prepared by SIMA in collaboration with the AERE. The new edition, which is in a new form, summarizes all the necessary equipment and gives the U.K. sources. Copies are available from The Secretary, SIMA, 20 Queen Anne Street, London, W.1.

R. STANSFIELD RETIRES

R. Stansfield, who joined the Anglo-Iranian Oil Co. Ltd. in 1925, retired at the end of December. During his 26 years at the Company's research station at Sunbury-on-Thames, he has been responsible for the development of the Engine Research Section and for the development of many new fuel testing techniques.

For many years he has been active in the work of the IP in engine tests and at the time of his retirement was deputy-chairman of Sub-Committee No. 5—Engine Tests, and chairman of its Engine Tests of Lubricants Panel. Recently he was entertained at lunch by his colleagues on the Committee

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"Research" Essay Competition The publishers of *Research* are offering prizes of £100 and £50 for papers discussing the possible industrial applications of some recent scientific investigation, whatever its origin. Papers, which should be about 3,000 words in length, should be written in a manner which will enable an intelligent reader with a general scientific interest to appreciate the argument. Manuscripts should reach the offices of *Research*, 4, 5, 6 Bell Yard, Temple Bar, London, W.C.2, on or before 30 April 1953.

COUNCIL COMMENTARY

The first Council Meeting of the New Year was held on 14 January with the President in the Chair. The General Secretary was asked to convey to Mr C. A. P. Southwell, the immediate past-president, the Council's congratulations on his appointment to the C.B.E. in the New Year Honours.

The Election Committee, in presenting their report, brought to the notice of Council three cases of members who, according to our Byelaws, could be considered for a reduced annual subscription.

The Awards Committee have decided to award the Redwood Medal in 1953 to Dr F. P. Bowden, F.R.S., Reader in Physical Chemistry at Cambridge University, and head of the Research Laboratory on the Chemistry and Physics of Surfaces. Dr Bowden, who has had many contacts with the petroleum industry over many years, will give his Redwood address early in the 1953/4 Session.

Two new suggested branches are under discussion—an Irish branch and an Australian branch. Northern Ireland have taken some steps to organize those interested and have asked that the IP should send over one or two lecturers to stimulate interest. The Branch lecturer, Mr E. A. Evans, will arrange to visit Ireland for this purpose. Southern Ireland may also be interested in these developments and the formation of a joint Irish branch may be possible in the future.

The Annual General Meeting for 1953 is to be held on 21 April, at 26 Portland Place, and will be followed by the President's address.

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C. C. Wakefield & Co.—The Board of Messrs. C. C. Wakefield & Co. Ltd. issued the following statement on 5 February: "Recent references and suggestions in the press of possible negotiations between this Company and a petroleum company are entirely without foundation."

IRAQ PRODUCTION DOUBLED IN 1952

With a total of 18,060,797 tons produced in 1952, the Iraq production of the Iraq Petroleum Company and Associated Companies was more than twice that of 1951, the details for the two years being:

	1952	1951
	Tons	
Kirkuk (Iraq Petroleum Co.)	15,552,715	7,987,024
Zubair (Basrah Petroleum Co.)	2,238,177	121,405
Ain Zalah (Mosul Petroleum Co.)	269,905	5,756
	18,060,797	8,114,185

The large increase in the output from the Kirkuk field was made possible by the opening of the 30-inch pipeline to the Mediterranean in April, thus augmenting transport which had previously been by one 12-inch and one 16-inch line.

Exports from Ain Zalah began towards the end of the year with the opening of 12-inch pipeline 134 miles long from that field to K.2 pump station on the main line.

For the Zubair field 1952 was the first full year and the production from this field has to reach 8 million tons by 1955 under the terms of the concession.

Production from the Qatar field in the Persian Gulf by Petroleum Development (Qatar) Ltd. was 3,245,343 tons in 1952, nearly 40 per cent higher than the 2,332,214 tons for 1951.

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TETRA-ETHYL LEAD EXPORTS

Exports of tetra-ethyl lead from the U.K. during 1952 totalled 963,254 gal (1,147,128 in 1951), the value being £2,281,657 (£2.63 per gal) compared with £2,436,657 (£2.12 per gal) in 1951.

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"The Stabilizer"—This magazine, the periodical publication of Lincoln Electric Co. Ltd., is now being printed in Great Britain and copies are available on application to the company at Welwyn Garden City, Herts.

PETROLEUM IN PARLIAMENT

Hampshire Refinery

In a written reply on 22 January, the Parliamentary Secretary to the Ministry of Fuel and Power, said that negotiations for acquiring the land needed for the projected refinery between Titchfield and Warsash had not been completed, and no plans for the erection of a refinery had been submitted.

Dollar Oil

The Minister of Fuel and Power in a written reply on 26 January said that the total dollar cost of oil used in the U.K. in 1952 was about £54 million f.o.b.

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KUWAIT PRODUCTION

With a production of 2,974,981 tons in December, the total output of crude petroleum in Kuwait in 1952 was 37,042,122 tons, an increase of 33.3 per cent over the 1951 total of 27,783,170 tons. Thus, daily output in 1952 averaged 101,208 tons, compared with 76,118 tons in 1951.

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HD OILS

In addition to the oils mentioned in this journal (December 1952, page 433), the following have been approved by the Director of Chemical Inspection, Ministry of Supply, as complying with the requirements of defence specification DEF 2101, Grade OMD 110:—

Suppliers' Nomenclature	*Supplier*
Esstic H.D.30	Esso Petroleum Co. Ltd.
Viscolene H.D.30	A. E. Bennett & Co. Ltd.
Chevron B.G. H.D.30	Berry Wiggins & Co. Ltd.
Filtrate D.M. Engine Oil	Edward Joy & Sons Ltd.
Celerine DEF H.D.30	Liddiard Lubricants Ltd.
Liadgo H.D.30	James Light & Son Ltd.
Ragosine Minerva SAE. 30	Ragosine Oil Co. Ltd.
Diesolene H.D.30	J. W. Miller & Son Ltd.
Omegal DM.30	Liberty Oils Ltd.
Motoleo GL HD.30	Alfred Hopps, Sons & Co. Ltd.
Wiggex H.D.30	Edward Wiggins & Co. Ltd.
Shell Oil S.3507*	Shell Mex and B.P. Ltd.
Brit-Gulf X. H.D.50†	Gulf Oils (Great Britain) Ltd.
B.P. Energol Diesel D-S.A.E.50†	Anglo-Iranian Oil Co Ltd.

*Grade OMD 60
†Grade OMD 330

"THE STANLOW STORY"

"The Stanlow Story" is the record of the construction of a 4½ million tons/year refinery, a giant jigsaw which took nearly four years to assemble.

Introducing the film, C. M. Vignoles, managing director of Shell-Mex and B.P., reminded his audience that British refining capacity had risen from three million tons in 1946 to more than 24 million tons today. Of this total, Shell and AIOC together were responsible for over 17 million tons.

The film is intended for a wide audience, so technicalities are not entered into. An excellent general idea is given of the work involved in turning a tract of "marshland, subject to floods" into a modern refinery the skyline of which rivals anything thought up by the Festival of Britain architects for the South Bank Exhibition.

Construction was in four stages, with a major plant and its ancillaries coming into operation at the end of each phase. The camera unit was on location throughout, following the operation step by step in what appears to have been unremittingly inclement weather. The labour force, at peak numbering 4,000, are shown doggedly at work in snow, knee-deep in water and slush, in driving rain and sleet, occasionally pausing to glance up with approval at the successful conclusion of some delicate lifting operation.

Some effective camera shots were taken from the parapet at the top of the 340-ft cooling tower, whose streamlined modern exterior is in complete contrast to its vast strutted interior, so reminiscent of a gothic cathedral that the accompanying background music is played on an organ!

The film may be borrowed from Shell-Mex and B.P., or from Petroleum Films Bureau.

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COMPANY PRODUCTION CRUDE OIL

	Dec., 1952 Tons
Iraq Petroleum Co. Ltd. (Kirkuk field)	1,708,376
Basrah Petroleum Co. Ltd. (Zubair field)	252,670
Mosul Petroleum Co. Ltd. (Ain Zalah)	100,163
Petroleum Development (Qatar) Ltd. (Qatar, Persian Gulf)	322,540

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Philips Electrical Ltd. have made available a new industrial catalogue (PD 3444) of the full range of their products listed under headings such as arc welding, resistance welding, etc. Useful data are given and copies are obtainable from Century House, Shaftesbury Avenue, London, W.C.2.

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FLOODS AT CORYTON

Damage at Coryton refinery of Vacuum Oil Co. Ltd. was mainly confined to electrical equipment and construction supplies and little delay in work is anticipated. This photograph shows flooding in one of the pipe tracks. It was later reported that all repairs were completed and the plant on stream in 21 days.

INSPECTION OF REFINERY EQUIPMENT*

By E. J. M. TAIT (Member)

Vessel Liners

There are two principal kinds of liners for protecting vessels against corrosion. These are alloy liners, usually of 11 to 14 per cent chrome material where protection against sulphur corrosion is required and gunnite liners which consist of 1 part lumnite cement and 3 parts aggregate retained by a $\frac{3}{4}$-inch hexagon steel grating welded to the wall of the vessel.

Alloy Liners

These are of two types, shop installed and those installed in the field, the first being usually attached to the plates from which the vessel is fabricated before they are welded together.

Field installed alloy liners are usually of about 0.078 to 0.106 inches thickness and may be either of the plug-welded or strip-welded type; in the plug-welded type of liner, sections of alloy sheet small enough to pass through the manhole of the vessel and drilled with $\frac{3}{4}$ to $\frac{7}{8}$-inch holes on 3 to 4-inch centres are used; the liner is welded to the wall through the drilled holes, beginning in the centre of each section and working towards the outside and finally welded all round the edges.

Because of the difficulty in getting this type of liner to adhere closely to the wall and of the tendency to form bulges between the plug welds after some time in service, this type of liner is not so popular as the strip liner.

The strip liner consists of strips of material 3 to 4 inches wide, depending upon the operating temperature of the vessel and usually about 4 ft in length; they can be welded either horizontally or vertically to the wall of the vessel, but the horizontal method which usually gives better results is generally used.

There are several methods of welding the strip. Some prefer the three-bead method in which one bead is used to weld all round each section of strip, the third bead being used to fill up between the adjoining beads of each strip while others prefer the two-bead method which means considerable economy in electrodes. For installing this type of liner 25/20 chrome nickel electrodes, generally $\frac{1}{8}$ inches diameter are used, the amperage being held at 90/100 to keep the temperature as low as possible during welding.

Due to the uneven surface of the walls alloy liners cannot be installed in vessels which have suffered serious corrosion, and for this reason such vessels are generally protected by means of gunnite or gannister lining.

Gunnite Liners

These consist of lumnite cement and aggregate supported by hexagon steel grating. The grating is cut into sections narrow enough to pass through the manhole and about 6 ft long and welded to $\frac{3}{8}$ inches round bar strip; after rolling to the correct radius of the vessel, the grating is installed by welding the round bar strip to the wall of the vessel. In the case of the top and bottom heads of the vessel, the grating is cut into orange peel sections; it is, of course, necessary to fit each section properly in position before finally welding.

The gunnite can be applied either by air-driven cement gun or by hand, the latter being better as when the gun is used a great deal of material rebounds from the wall and settles in the bottom properly cured; this is most important as the success or failure of the liner depends mostly on the curing. The liner is allowed to air cure in the atmosphere for 8 hours and at no time should the surface of the liner become dry. It is then sprayed with water for 16 hours; a fog nozzle is very useful for this

*Continued from p. 73.

purpose. Following the spraying, the liner is allowed to air cure in the atmosphere for 8 hours, the surface of the liner still being kept wet; after air curing the liner is then steamed for 8 hours with both manholes opened followed by further steaming for 8 hours at 100 p.s.i. pressure. Finally, the chamber is opened and the lining allowed to dry for 4 hours.

Another advantage of the gunnite liner over the alloy type is that it acts as insulation to the walls of the vessel and therefore enables higher pressure to be carried than in unlined or alloy lined vessels. Also gunnite liners are cheaper to instal and in some cases to maintain than alloy liners. It should be remembered however that the wall of the vessel must be thoroughly cleaned before installation of any type of liner is attempted. Any oil or coke will prevent the liner from adhering properly to the wall and for this reason sandblasting should in all cases be carried out.

Process Piping, Valves, and Fittings

Most process piping is fabricated to comply with the American Code for pressure piping which strictly controls the minimum wall thickness of piping and fittings.

Piping

This section of the equipment is the most important of any, from an inspection point of view, particularly in the more modern type of refinery unit where piping is exceedingly complex, and even in a comparatively small unit includes a large number of valves and fittings together with main and by-pass lines, lines to controllers, liquid level, etc. In the earlier units, before automatic control came into its own, process piping was a comparatively simple part of the equipment to inspect, but the adoption of the various and involved types of control has meant an enormous increase in the amount of work necessary at an inspection.

At the outset, it can be said that there is only one sound method of inspecting any section of process piping and that is to dismantle it completely and break all joints.

Process lines should be cleaned as thoroughly as possible, if necessary by means of a mechanical cleaner, and the ends of each section should be cleaned by hand so that the caliper reading will show the correct wall thickness, free of scale and coke.

In many refineries, the usual practice is to erect wooden scaffolding and platforms around lines which are difficult to dismantle and lower it to the ground because of lack of proper equipment. In other cases, bo'suns chairs are sometimes used for the same reasons, though it is not possible for the inspector to make a detailed and thorough examination of any section of piping if he is lying on a plank 60 ft above ground in a strong wind; the author had this experience on one occasion in Italy and was extremely lucky to find a weak section of 8 inches 600 lb pipe in which the wall thickness measured less than 3/64-inch. It is therefore recommended, wherever possible, that all process piping should be completely dismantled and lowered to the ground.

If an inspection is to be properly carried out, every assistance should be given to the inspector to enable him to cover all the equipment in detail and no single item of equipment, however small, should be overlooked; as stated elsewhere, failure of one $\frac{3}{4}$-inch nipple can cause a shutdown just as easily as the failure of a 4-inch fitting, though the consequences may not be so severe.

There are on the market, several instruments for measuring the wall thickness of piping. There is, however, a lot to be said for the old method of hammering and test drilling, in fact, experience shows that this is the most thorough and rapid method of inspecting process lines.

In cases where, due to more severe

operating conditions, process piping has to be retired while considerable wall thickness still remains, hammering does not give such a good indication of weakness, neither does it show up corrosion in the form of pitting, which incidentally seems to occur in 4 to 6 per cent chrome moly piping after five to six years continuous service. Pitting can only be discovered by an internal examination of the line.

Experience shows, however, that on the whole hammering very often reveals weak or soft spots which might not otherwise have been discovered until too late.

This was brought to the author's notice many years ago in an unforgettable manner; corrosion in a hot oil pump discharge line operating under 600 p.s.i. pressure at 700° F. was believed to be concentrated at the flanged ends of each section.

Caliper measurements at the flanges indicated that the line was good for a further 1000 hours before retirement. However, after 894 hours on stream, one length ruptured, causing a bad fire. Subsequent measurements indicated that while the thickness at the flanges had not decreased since the run began, the middle of the length had a wall thickness of under 0 07 inches and had the line been hammered, when caliper readings were taken, this accident would have been avoided.

An inspector has two methods of judging the condition of piping when hammer testing. First, he knows at once by the ring whether the wall is thin and can tell by the "feel" of the hammer when he strikes whether or not the pipe is soft; should either of these conditions be suspected, he then marks his test holes for drilling. When making test holes it is a good plan to number each one consecutively, stamping the number alongside the point to be drilled. At the same time the exact location of the drilling is noted in writing so that when the inspection of the unit is complete, each hole can be checked and ticked off when it has been plugged and welded.

If this is not done, it is quite possible for a test hole to be left unplugged and if, as is sometimes the case, it is not discovered until the unit has been filled with oil for testing, much time will be wasted.

To avoid delay in inspecting piping, it is a good plan to have following the inspector a man with the electric or air drill who, taking each section of line in turn as handed over by the maintenance department, hammer-tests, marks, and numbers his test holes as he goes. When he has reached the end of the section, he goes back and measures the wall thickness through the test holes, stamping on the pipe the thickness found and the date and entering them in his notebook. This practice ensures that two records are available and in the event of any doubt, the actual reading can be checked by reference to the stamping.

Then should follow the man with the tap and plugs which should be tapered and of such length that they will not project through the wall of the pipe, otherwise turbulence will occur round the projecting portion of the plug, thus encouraging corrosion; this will most often be noticed when an alloy plug is fitted into a carbon steel line.

Since alloy material came into use, the amount of inspection work on any unit so equipped has been greatly reduced; in fact, the adoption of alloy piping and fittings has been a godsend to refineries all the world over. Previously the practice was to use double extra heavy pipe. This certainly resulted in a longer life but the practice of providing more metal to corrode away could not be regarded as economically sound. With the advent of alloy piping and fittings, the problem of corrosion was more or less brought under control while at the same time inspection work was greatly reduced.

Valves and Fittings

The larger process valves and fittings in modern refineries are mostly standard flanged cast steel of the appropriate series and, apart from corrosion and normal wear and tear, gives very little trouble.

For inspection purposes, valves, whether globe, gate or check, should be dismantled and thoroughly cleaned; in some refineries, all the larger valves and fittings are sandblasted and this is good practice, provided, in the case of valves, the seat is protected.

Another practice which has become general during the present emergency is that of prolonging the life of cast steel valves and fittings by building up with welding rod. As a rule deterioration in valves and fittings, particularly ells, is localized; in a globe valve, it usually occurs at the inlet where the flow follows the curve of the body before passing up through the seat and in an ell at the outside of the curve where the velocity is greatest. These two locations, if watched and built up regularly, will usually enable a valve or fitting to be retained in service for years.

It cannot be accepted, however, that corrosion in valves and fittings will always be of a localized nature and when either of these items is inspected, every accessible part of the body should be calipered and examined for flaws or cracks. The inspector will find by experience the thinnest part of any particular type of valve or fitting and should check this location before making a general survey of the body.

The best method is to run the caliper all over the body noting the location of the thinner places and then come back to them and take as accurate measurement as possible.

It is most important, particularly in the case of valves, that they are properly cleaned—sandblasting is recommended—before measurements are taken. If fittings are merely wiped out with a piece of oily waist a thin layer of coke is left in the body; this will result in inaccurate measurement and the retention of valve in service when it should have been retired or removed for reinforcement by building up with welding rod.

Tees and spools can be lined if the indications are that corrosion is excessive. If alloy sheet is available this can be used; however, in an emergency, ordinary mild steel plate will afford some measure of protection. The liner should be rolled into the form of a sleeve with the joint left opened about $\frac{1}{8}$-inches. It should be made a tight fit and after placing in position welded to the parent metal at the joint and round the edge of the flanges; where the fitting is 8 inches or larger, it is better to make up the liner in four strips to prevent the bulging which is likely to occur if it is installed in one piece. Even though the liner is of mild steel and corrodes relatively fast, it will at least prevent rapid deterioration of the fitting.

Relief valves, of course, will be given special attention and in addition to measuring will be carefully examined before re-assembly; disk, seat, spindle, spring and guides should be carefully examined. The disk will generally require grinding, but, if leakage has taken place, it may require refacing. Springs sometimes become fatigued and for this reason it is a good plan to renew them at stated periods.

After assembly, the valve is tested first for tightness in the closed position and then to see that it opens and closes at the correct pressure.

The test should be witnessed by the inspector together with the plant superintendent who should then sign the book noting at the same time the test pressure. It is usual in most refineries to keep spare valves for each location, one being overhauled while the other is in service. If this is the case, it is most important to see that the correct valve is installed on the unit; instances have

occurred where the valve due for overhaul has been replaced and much valuable time has been wasted in consequence.

It is, of course, essential that valves should be replaced in the position from which they were removed for inspection. Failure to do this will prevent accurate corrosion rates being obtained and will lead to trouble sooner or later.

Heat Exchangers

Because of the necessity of economy in heat input, whether gas or fuel oil, an important part of any refinery unit whether designed for distillation or cracking service is heat exchanger equipment which comprises reboilers, condensers, coolers, etc.

There are in service at the present time, two principal types of heat exchanger, namely the G-fin type and the widely-known shell and tube type. The G-fin type consists of a number of inner finned elements fitted inside an outer casing and in which the flow is countercurrent; the cold charge passing through the inner element and the hot product flowing between the parallel fins on the outside of the inner element. This type of heat exchanger is generally used on preheater service on lighter products and gives good service. It is easy to open up and inspect and there is not much to go wrong with it except that the fins on the inner element which are naturally fairly thin cannot be replaced when they are corroded or worn away and the element has therefore to be replaced. However, on most services these finned elements have a service life of 3 to 4 years.

The shell and tube type of heat exchanger is used all over the world on many different services. It consists of a shell, usually of mild steel plate, and a tube bundle consisting of a number of tubes expanded into two tube sheets one of which is floating to allow for expansion; the other is fitted to a channel head which contains the necessary baffles to direct the flow through the tubes. The channel head cover closes the vessel on one end, an outer cover fitted outside the floating head cover closes the other end; this cover is often known as the beaver head.

At a general inspection, all heat-exchanger equipment, tube bundles and covers are opened up, removed and cleaned for inspection. It is usual practice to keep a certain percentage of spare bundles available for an emergency and in any case the tube bundles which are known from the records to have been longest in service are automatically replaced by the spare bundles at a general inspection. The other bundles are then inspected and tested after cleaning and any tube replacements found to be necessary are carried out. The shell and heads are calipered and any hollow places built up with welding rod, provided they are not too excessive.

Many kinds of tubes are used in heat exchangers depending upon the service in which they operate; in cracking service, exchangers are used mainly on reboiler and condenser services.

Reboilers

Carbon steel tubes and tube sheets are generally used on this service. Corrosion of tubes on the outside is usually evenly distributed while on the inside of the tubes where the heating medium flows, the first tubes in each pass are generally affected by corrosion or erosion at the inlet end, more particularly on the first pass and decreasing through the tube bundle. The average life of carbon steel tubes on reboiler service is 2 to 3 years. In some cases stainless tubes either of 4 to 6 per cent chrome molyb or 18/8 chrome nickel have been used; however, these do not always result in any great increase in service life and in view of their high cost compared with carbon steel tubes their use may not always be justified. In some cases, erosion has been found on

channel covers on reboiler service and these can be repaired either by building up with welding rod or by installing 11/14 chrome sheet liner.

Condensers

In condenser service, Admiralty metal tubes and bronze tube sheets are generally used although in some cases dezincification and stress corrosion cracking have necessitated their replacement by aluminium brass tubes which give much better service. An instance occurred some years ago where the triplex steel studs on the floating head joints of several depropanizer condensers were found to be fractured on opening up of the exchangers for inspection. These studs were all standard specification ASTM A-96, Class "B", and coupons cut from the fractured studs and tested on the tensile testing machine were found to be practically identical with the original specification and there appeared to be no clear reason for their failure. Similar studs again failed shortly after on this service and the question was taken up with the suppliers. No satisfactory solution was reached although it was believed that intergranular corrosion may have taken place. Mild steel studs were subsequently used on this service and have given no trouble up to the present.

In some cases, the lower half of condenser shells have been found to have lost considerable thickness by corrosion and provided this is not excessive, the shells can be turned 180° so that the thin portion is on the top, where corrosion does not occur. This, of course, cannot be done where the shell has decreased to a point where it necessitates a reduction in the safe working pressure.

Miscellaneous

A number of other items which need to be inspected on a regular basis are grouped together under the above heading.

Pumps are generally maintained by a separate branch of the mechanical engineering department which keeps an independent set of records of performance and repairs; however, when pumps are operating in any service which is liable to lead to corrosion, the inspection department is generally called in by the pump maintenance department to make the necessary recommendations. Hot oil pumps on residuum service sometimes experience corrosion around the seats and in this case unless a spare pump block is available considerable time is necessary to remove the pump block from site and build up with the necessary welding rod and then machine to size. Apart from pumps on acid and treating plants service which are not dealt with in this paper, corrosion is not generally excessive.

All pressure gauges should be checked over by means of a standard deadweight tester which provides a double check by means of the standard gauge and weights, and all gauge lines should also be tested to see that they are correctly filled and the necessary correction made for liquid head.

Pyrometer wells must be removed and thoroughly cleaned for inspection; in this connexion, care must be taken to see that all are stamped with a number so that they can be replaced in the correct location. After calipering, provided renewal is not necessary, all should be subjected to a pressure test; those operating under normal conditions can be tested at 1,000 p.s.i. pressure but for those operating under high pressure, the test pressure will have to be adjusted accordingly. Threads should be closely examined and also the threads of the boss into which the well is screwed; after replacement and before the unit is tested out a further check should be made to see that none of the thermowells are installed with crossed threads.

Testing and Cleaning up

When the inspection is complete, all measurements should be checked and test holes inspected to see that they have been properly plugged and seal welded, Joints should be looked over to see that everything is properly tight.

Each major vessel is then closed up, all connexions blanked off, filled with water and given an individual hydrostatic test, usually one-and-a-half times the safe operating pressure. When close examination shows that all leaks are tight, the water is drained off, blanks removed and the vessel is now ready for testing out with the remainder of the system.

The unit should then be filled with gas oil and tested out; it is better to test in sections so that the correct cold test pressure may be applied and, when filling up, it is most important to see that all air is completely vented from the system before the test pressure is applied. The relief valve will, of course, be locked down in each case before the test and when everything has been found tight, the pressure is dropped by bleeding or draining off until it is below the releasing pressure of the relief valve. The key is then taken out of the relief valve and the pressure raised to the point where the relief valve opens; it may be that the valve will be a bit sticky, and it should be tried several times and adjusted until it opens and closes correctly; even though the valve has worked correctly on the valve shop test pump, it may be a little stiff when tried out on the plant and care must be taken to see that the unit is not given permission to start up until all safety valves are working properly and the locking key in each case removed from the valve and placed on the board provided in the control room.

When the inspector concerned has satisfied himself that all replacements and repairs recommended have been correctly carried out and that the unit is in a safe condition for operation, he may then sign the permit giving the necessary permission for the unit to start up. He should also check the general condition of the area apart from equipment and make sure that all trench plates are in position and that no pieces of wood or rope should be left around to catch fire.

Before testing of the individual items of equipment begins, the revised pressure schedule, incorporating any reduction in pressure which may have been necessitated by deterioration of equipment, should be posted in the control room so that the operating staff will be able to test out to the correct pressure.

★ ★ ★

At the recent annual dinner of the British Industrial Measuring and Control Apparatus Manufacturers' Association (BIMCAM), the chairman, L. S. Yoxall, expressed disappointment with the terms of the Government loans to industry to increase fuel efficiency and said it was common knowledge that measuring instruments gave a greater fuel return than any other type of equipment.

FORTHCOMING MEETINGS

THE INSTITUTE

A Symposium on the Examination of Used Lubricating Oils. At 26 Portland Place, London, W.1, 5.30 p.m. (*tea* 5 *p.m.*), 24 March.

The Present Status of the Art of Cracking. W. C. Dickerman, Jr., Ph.D., M.S. (*The Lummus Co.*). At 26 Portland Place, London, W.1, 5.30 p.m. (*tea* 5 *p.m.*), 8 April.

A Symposium on Engine Testing of Lubricating Oils. At Institution of Mechanical Engineers, Storeys Gate, St. James's Park, London, S.W.1, 2.30 p.m., 22 April.

Fawley Branch

Plastics. Harry Barron, B.Sc., Ph.D., F.R.I.C. At Esso Recreation Club, Holbury, 7.30 p.m., 20 March.

Motor Racing Films. Introduced by R. R. Tanner. At Esso Recreation Club, Holbury, 7.30 p.m., 17 April.

London Branch

Address by the President. At 26 Portland Place, London, W.1, 6 p.m. (*tea* 5.30 *p.m.*), 25 March.

Some Design Philosophy and Engineering Procedure in Petroleum Plant Construction. R. C. Fisher, Dr.Ing., M.I.Mech.E., M.I.Chem.E. Followed by **Fork Supper.** At 26 Portland Place, London, W.1, 6 p.m. (*tea* 5.30 *p.m.*), 27 April.

Northern Branch

Lubrication—Chemist or Engineer? E. A. Evans, F.R.I.C., M.I.Mech.E. At Engineers' Club, Albert Square, Manchester, 6.30 p.m., 17 March.

Oil and the Manchester Ship Canal. W. G. Edmonds. At Engineers' Club, Albert Square, Manchester, 6.30 p.m., 21 April.

South Wales Branch

Fuel Oils—Distribution and Uses. T. D. Ambrose, B.Sc. At Training Centre Cinema, National Oil Refineries Ltd., Llandarcy, 5.30 p.m., 9 April.

Stanlow Branch

Lubrication—Chemist or Engineer? E. A. Evans, F.R.I.C., M.I.Mech.E. At Grosvenor Hotel, Chester, 7.30 p.m., 18 March.

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Parallel with the return of premium grade petrol, Esso Petroleum Co. are offering to the farming community an improved tractor vaporizing oil.

At a recent press conference in London, the company's agricultural co-ordinator, F. W. Ellis, described the new product, known as "Esso Green," as a tractor fuel of very high volatility in the middle of the distillation range. The green dye, added to distinguish it from other fuels, had no deleterious effect on an engine. Production in the future would be at the now nearly-completed tractor fuel plant at Fawley and it would be marketed at the normal price operating for tractor fuels today.

Answering questions on the fuel's characteristics, E. J. Boorman, Esso's chief chemist, said its anti-knock quality was more than ample for any vaporizing tractor on the market today and that gum and sulphur content were at low levels.

★ ★ ★

British Chemicals.—The Association of British Chemical Manufacturers have recently issued their 1953 directory of "British Chemicals and Their Manufacturers". This 179-page book is a valuable guide to the source from which chemical products can be obtained. In addition, a useful list of proprietary and trade names is given. Copies are available gratis to those interested and are obtainable from the ABCM, 166 Piccadilly, London, W.1.

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Smiths Industrial Instruments Ltd.—This firm has recently opened an office in Manchester at York House, 12 York Street, Manchester 2 (telephone: Manchester Central 0858).

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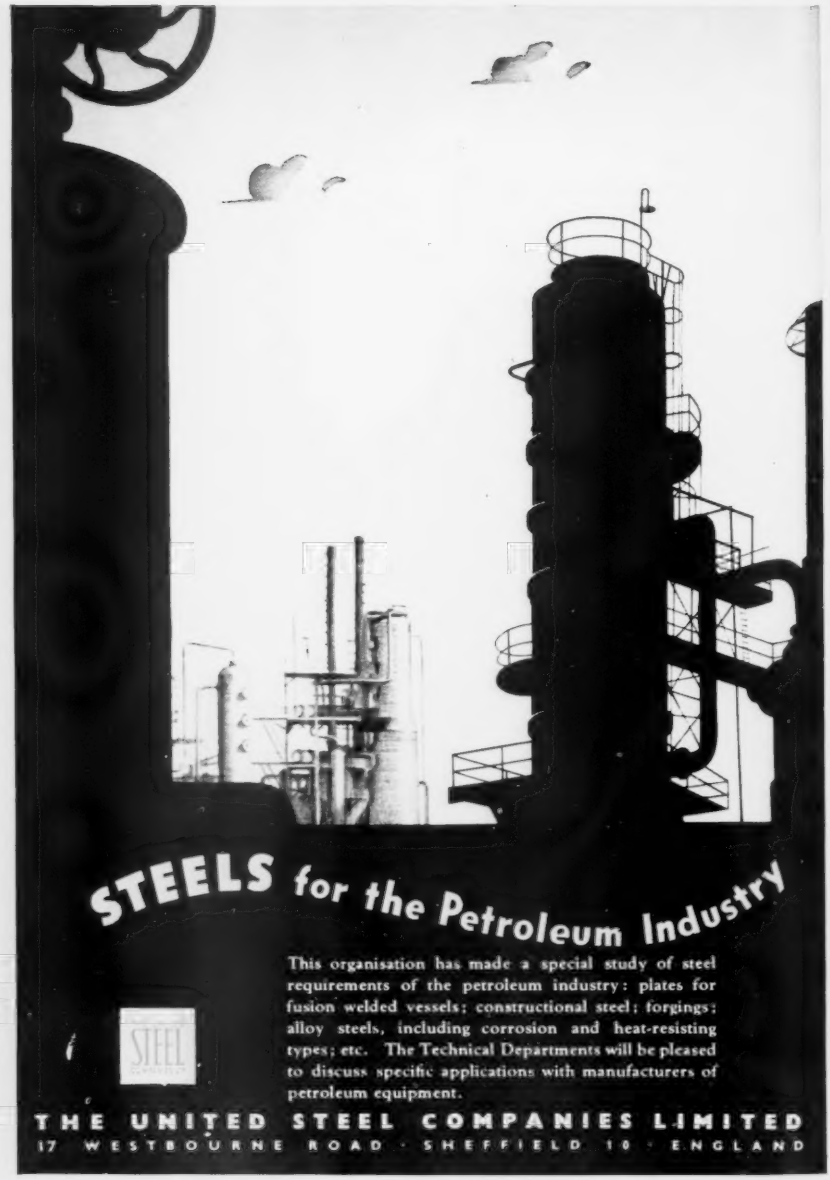
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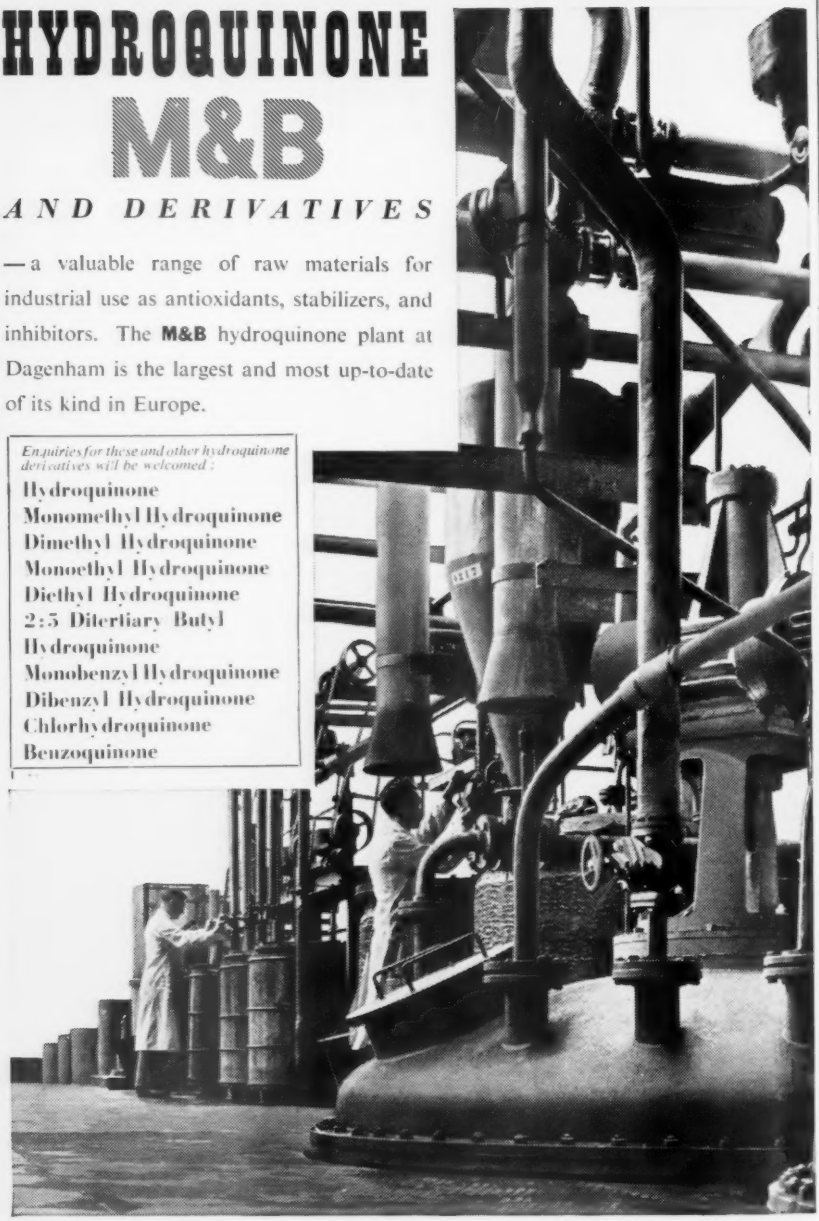

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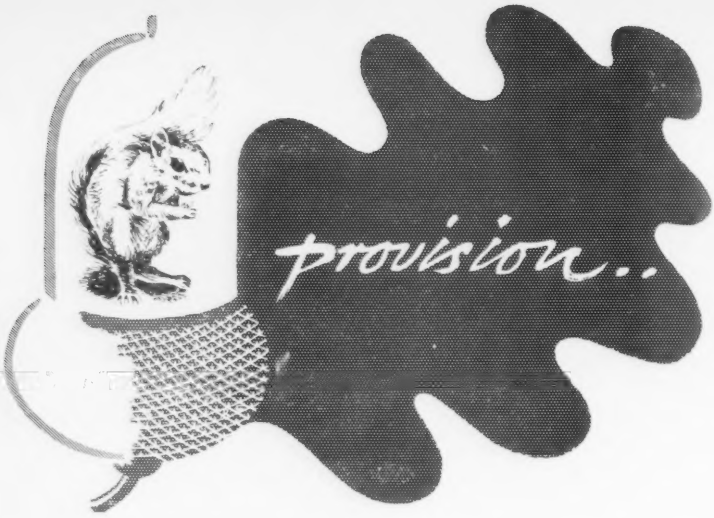

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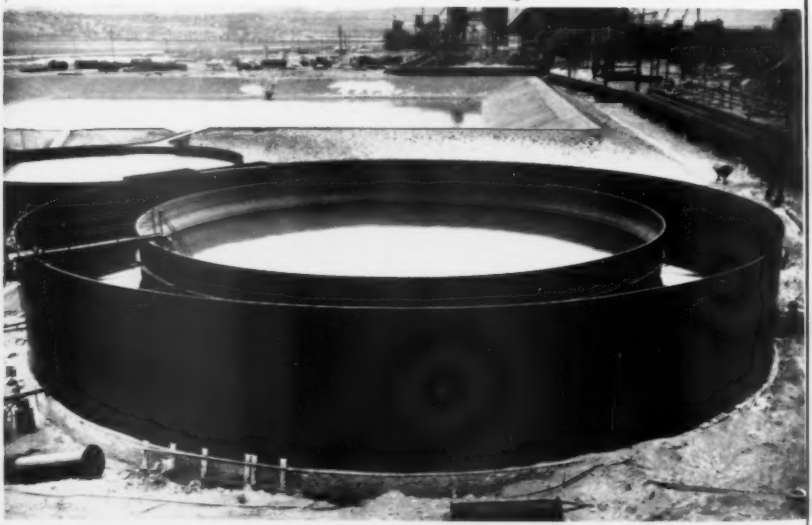

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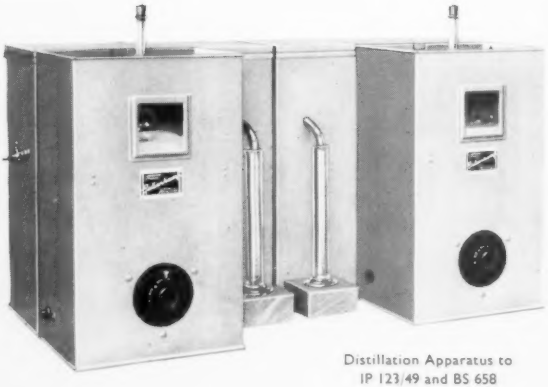

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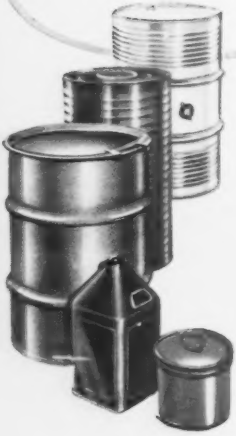

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